# Returns to Education

## AN INTERNATIONAL COMPARISON

GEORGE PSACHAROPOULOS

*Higher Education Research Unit,*
*London School of Economics and Political Science*

*assisted by*

KEITH HINCHLIFFE

*Ahmadu Bello University,*
*Zaria, Nigeria*

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This book has both an informative and an analytical function. The informative function is served by providing evidence on the economic returns to investment in formal education in a large number of countries. The analytical function is served by an attempt to make empirical generalizations from this evidence and thereby to throw some light on the role of education in the process of economic growth and development.

Concern for education by economists started about fifteen years ago when empirical investigations in the United States revealed that output was growing much faster than inputs as conventionally measured. The part of the growth of output unaccounted for by conventional inputs came to be known as the "residual" or the "coefficient of our ignorance". Original explanations of the residual such as "technical change" or "shifts of the production function" were of little help analytically. How could a country shift its production function or induce technical change so as to achieve a higher level of output?[1]

This led researchers to try to open the black box of technical change and reduce the unexplained residual. The main initial development was the quantification of the increase in the quality of labour inputs and this led to the creation of a new field in economics known as the "economics of human capital", or more narrowly, the "economics of education".[2] Since then there has been an almost 180° shift of emphasis in development planning, the emphasis changing

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[1] For the earlier classics see Abramovitz (1956), Solow (1957), Fabricant (1959) and Schultz (1961). For further discussions see Denison (1962 and 1967), Griliches (1963), OECD (1964) and Bowman (1971). For a critical view see Balogh and Streeten (1963).

[2] In fact it was a rediscovery, since people as far back as Adam Smith and as recent as Marshall had already written about the economic consequences of education. For the historical evolution of the field see Bowman (1966), Blaudy (1967) and Kiker (1966 and 1968).

from physical to human capital as the major source of growth.[3]

Once education had been seen as an investment, the next question was: what is the monetary pay-off from this investment? For, if the objective is an efficient allocation of resources between different uses, the yield on investment in men has to be compared with that on investment in other forms of capital. Suppose, for the moment, that the returns to investment in human capital can be satisfactorily measured. Then, if the returns to investment in a particular educational level are higher than the returns to physical capital, we would conclude that there is under-investment at this level of education. Conversely, if the returns to human capital are lower than the returns to physical capital, then investment in the second form of capital should be given priority. Therefore, at the centre of any discussion of optimal resource allocation lies the concept of a profitability measure of investment in education.[4]

Casual observation and statistical data indicate that people with more education earn higher wages relative to people with less education. For example, the average earnings of a male college graduate in the United States in 1959 were $9,255 and the corresponding earnings of a high school graduate $6,132.[5] Therefore, a college graduate would expect to earn on the average during his working life a net $3,123 over what he would be earning as a secondary school graduate. But in order to enjoy this extra benefit he would have to invest a certain amount of money in higher education. The total private cost of four years at college in 1959 was estimated to be $14,768, which includes both direct expenses such as tuition fees and books as well as indirect costs in the form of foregone earnings while studying.[6] The investment equivalent of the above venture is that of buying a promise to receive annually $3,123 at a cost of $14,768 now. A simple calculation shows that the annual yield of this particular investment is about 20 per cent, and this is what is known as the internal rate of return to investment in higher education.[7] Rates of return to invest-

[3] The popularity of the field is witnessed by the increase in the items of Blaug's bibliography from 792 in the 1966 edition to 1358 in the 1970 one.

[4] On this matter see Solow (1963) and Schultz (1967).

[5] See Griliches (1970), Table 2.

[6] See Hines et al. (1970), Table A-1.

[7] The crude calculation is 3,123 : 14,768 = 0.21. Of course, this calculation assumes that the benefit will remain constant over time and that it will accrue for ever. A correction for a finite working-life horizon (equal to 43 years) reduced the above rate of return by 6 per cent of itself. The reader should bear in mind that this is just an illustration, and that actual calculations are much more complicated than the above example and involve many controversial assumptions (see Chapter 2).

ment in other levels of schooling can be computed in a similar fashion.

During the last decade, rate of return estimates to investment in education have become available for a large number of countries. What we have done in this book is to collect the scattered rate of return evidence for as many countries as possible and analyze these rates in relation to other economic characteristics of the countries involved. Our general aim in collecting and analyzing these data is to learn more about the role of education in the process of economic growth and development. In particular, we expect to answer the following major questions:

(a) How does the profitability of investment in education compare with the profitability of investment in physical capital? The policy implication of this comparison would be to throw some light on the question of whether a country should invest more in steel mills or in schools.

(b) Can intercountry differences in the stock of human capital help to explain differences in the level of per capita income? Alternatively, what contribution has investment in education made to economic growth in different countries? The policy implication of this analysis would be to clarify the issue of whether a country could expect to increase its per capita income or accelerate its rate of economic growth most by increasing its stock of human capital.

In addition we aim to provide information on:

(c) The structure of the rates of return by level of education. This comparison should help us to decide which levels of education should be promoted relative to the others within a given country.

(d) The degree of public subsidization education receives in different countries. This provides an answer to the question of the economic cost of political decisions regarding the provision of free education in different countries, and whether the subsidies can be reduced without impairing the incentives of people to receive the desired level of education.

(e) A new index of educational development based on costs. Such an index provides an alternative to the Harbison and Myers educational index which is based on enrolments weighted by more or less arbitrary figures.

(f) The earnings ratios of people with different levels of education within a given country. This information, when combined with the numbers of people with different educational levels, indicates the relationship between income distribution and education in different countries and gives estimates of the degree of substitution between

different types of educated labour. Such estimates have implications for the particular methodology to be used in educational planning.

(g) The economic returns of higher education graduates who emigrate to work in a foreign country. This information provides us with a partial explanation of the phenomenon of the brain drain.

The book is organized as follows: the rest of this chapter contains an impressionistic overall view of the main analytical procedures and findings. The next chapter introduces the reader to the rate of return types and to the multiplicity of computational adjustments that rate of return estimates may contain. Chapter 3 presents a summary of profitability estimates as found in the original studies, together with the particular assumptions used by individual authors. The taxonomy of the rates of return for the purpose of international comparisons is the subject of Chapter 4. Chapter 5 considers the allocative efficiency of investment in education by comparing the return to education with the return on alternative forms of investment. The subject of Chapter 6 is the relationship between physical and human capital in economic development, while Chapter 7 presents estimates of the part of the rate of economic growth attributed to education. In the last two chapters the rate of return is disaggregated into its separate cost and benefit components, and these data are used to test hypotheses centering around human capital in a number of countries.

## Which rate of return?

In Chapter 2 we present a theoretical introduction to the concept of the internal rate of return to investment in education. Particular attention is paid to the different types and to the labels often attached to rate of return estimates; we also examine a host of adjustments performed on empirical profitability estimates, either as necessary compromises because of lack of data or in order to approximate the theoretical definition of a given rate of return type. Therefore, in this chapter we explain what is meant by an average, marginal, overall, total, private, social, adjusted or unadjusted rate of return, and how these adjustments are made. Appendix A presents a sensitivity test of an actual rate of return calculation under alternative popular computational assumptions. The result of this test is that shortcut calculation procedures may over-estimate the rate of return to investment in education by as much as 16 percentage points.

Chapter 2 serves as an introduction to Chapter 3 which presents all the profitability evidence we have been able to discover. This evidence covers 32 countries in all continents. As more than one profitability study exists for some countries, the total number of studies reviewed is 53. The profitability evidence presented in Chapter 3 is as found in the original studies without any attempt to match classifications or assumptions for comparative purposes. Studies of methodological interest are discussed briefly. In Appendix B the reader will find a concise presentation of the features of each particular study, for example: the sample size used, whether private and/or social rates were computed, and the types of adjustments made.

In Chapter 4 we select from the set of case studies reviewed the ones to be used in the international comparison. The comparability criteria were the comprehensiveness of the study and the provision of both private and social rates. Since matching different schooling categories was very difficult, we have re-computed certain rates in a number of cases so as to achieve comparability. The details of how we arrived at a set of more or less comparable rates of return by educational level in 32 countries are given in Appendix C. For example, in those cases where only social rates of return were computed for a country study, but where the original age—earnings profiles were provided, we have computed the private rates. Further, the profitability evidence is organized in that chapter by different classifications so as to ease the search for any empirical regularities that might exist.

## Which educational level is most profitable?

After having settled on a set of more or less comparable rates, a search is begun for any obvious regularities that exist either in the structure of rates within countries or when the rates of return are viewed across countries.

The first pattern that we detect in our data is that rates of return decline by the level of education. Looking first at the social rates of return, the average for primary education is 19.4 per cent, for secondary 13.5 per cent and for higher 11.3 per cent. This pattern proved to be statistically significant when tested by means of the individual country observations. Private rates show a similar pattern between the primary and secondary level (23.7 per cent and 16.3 per cent, respectively) while the rate of return to the university level is 17.5 per cent. The second pattern in our data shows that the private returns to investment in education are about 3 to 6 percentage points higher than the social returns. The difference between private and social rates
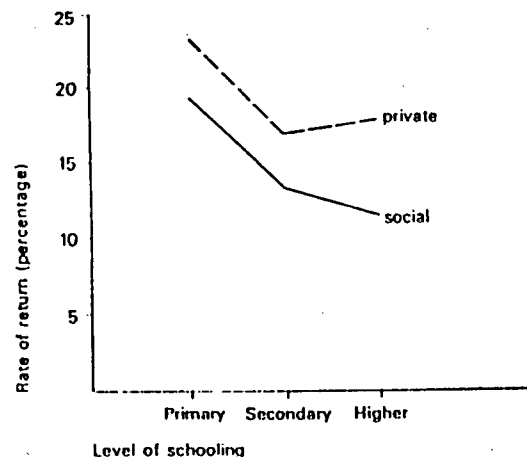
Figure 1.1. The private and social rate of return to investment in education by level of education (intercountry averages).

is even more pronounced in developing than in advanced countries, showing that the former group of countries subsidize their educational sector more heavily. The relationships between private and social rates of return by level of schooling are illustrated in Figure 1.1.

On the question of whether investment in the education of men is more profitable than in the education of women, the examination of 8 case studies where the returns for males and females are reported separately shows that, on the average, males show higher returns by about 2 percentage points at both the higher and secondary levels. The average return for males for primary schooling is 16.3 per cent while that for females is 9.8 per cent. Differences for secondary and higher education are much less pronounced (17.2 versus 15.5 per cent for secondary and 9.6 versus 7.2 per cent for higher, respectively).

The widely debated issue of whether a country should emphasize technical secondary rather than general education was not resolved, since it is very hard to draw any generalizations in view of the contradictory evidence we have on this particular point. For example, in Colombia the social return to technical education of males is substantially higher than the return to secondary general (35.4 versus 26.5 per cent, respectively) but this is not the case in the Philippines (11 versus 21 per cent) or Thailand where the return to secondary technical has a negative value ( −6 versus 9 per cent, respectively).

Another debatable question concerns the return to postgraduate studies. Where evidence is available on postgraduate programmes, the figures show very modest returns. For example, according to some

studies the rate of return to a Master's degree in the United States and Great Britain has a negative value, and a Ph.D. only a very modest positive one. This is because of the high foregone earnings of students who study for advanced degrees. It should be noted, however, that the completion of a Ph.D. carries a premium over the completion of a Master's degree. Wherever rates of return are available for the Bachelor, M.A. and Ph.D. the order of ranking is B.A. > Ph.D. > M.A. For example, in Great Britain the social rate of return to a Bachelor's degree is 8.2 per cent, to a Master's degree negative and to a Ph.D. 5 per cent.

higher education by subject, but the pattern is too mixed to provide any generalization.

Investment in schools or investment in steel mills?

This question is concerned with the allocative efficiency of investment in education. This kind of efficiency can be looked at from two main points of view or any combination thereof: private versus social efficiency, and efficiency within the educational sector itself or between the educational sector as a whole and the rest of the economy. Social efficiency, for example, requires equality between rates of return to investment in education at all levels and also that these are equal to the social rate of return on physical capital. Private efficiency has a similar meaning. A glance at Figure 1.1 shows that within the educational sector social investments have been far from efficient, particularly between the primary and secondary levels. Of course, there is no reason why one should expect social efficiency. Regarding private efficiency, the near identity between private rates for secondary and higher education shows that from the individual point of view there has been, on the average, the correct distribution of resources between these two levels.

In order to test the allocative efficiency between investment in education as a whole and in the other sectors of the economy, we had two tasks: first, to construct a single profitability measure of investment in education in each country, and then to compare this measure with the yield on physical capital. In Chapter 5 we have constructed an overall rate of return to investment in education in each country as a cost-weighted average of the individual rates for each educational level. The cost weights are derived in Appendix D, based on enrolments at a given level times the annual social cost of investment for that level of schooling. This kind of comparison was only possible for the social

returns and in just over half of the cases examined the rate of return to investment in education is higher than the rate of return to physical capital as measured. However, this generalization is subject to a wide variation regarding the individual countries and levels of education. Breaking the sample into developed and less-developed countries the following pattern emerges. While in the less-developed-country group the average return to investment in education (19.9 per cent) is higher than the average return to physical capital (15.1 per cent), the opposite seems to be the case in advanced countries (returns of 8.3 and 10.5 per cent, respectively). This relationship between the return to the two forms of capital by level of development is illustrated in Figure 1.2.
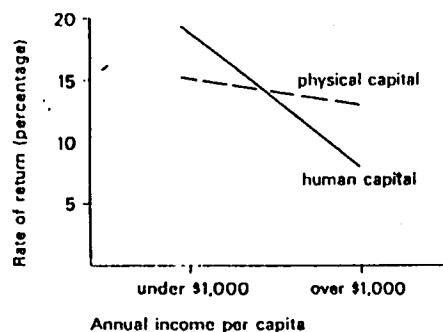


Figure 1.2. The social rate of return to physical and human capital by level of economic development (intercountry averages).

## The returns to education and the level of per capita income

The above-suggested relationship between the level of development and the returns to investment in education is examined in a theoretical context in Chapter 6. Using an aggregate production function with human capital as a separate input, we see that the reason for the declining rates is simply a reflection of the law of diminishing returns to investment in this form of capital. That is, the more one country invests in education, keeping all other factors of production constant, the less will be the payoff to that investment at the margin. Our data confirm this expected negative relationship, although the slope of the curve is not statistically significant. The reason for this is that countries differ in other resources as well, such as physical capital, and this difference upsets the theoretical relationship.

The overall actual relationship between the returns to investment in education and per capita incomes is shown in Figure 1.3. Two patterns seem to emerge from this figure. First, by taking the sample of countries as whole, there is an overall negative relationship between the rates of return to investment in education and the level of economic development (broken line A—C). Second, by disaggregating the sample into developed and developing countries, a U-shaped pattern is obtained; i.e., the returns to education are declining at first until a certain level of development is reached, at which point the returns start to rise along with the level of development (solid line ABC). The first pattern and the first half of the second pattern are all consistent with our theoretical expectations, i.e., diminishing marginal returns to investment in education. Our explanation of the second part of the U-shaped pattern, the upward sloping BC curve in Figure 1.3, is that human capital is a complement to the high level of technology employed in rich countries.[8]
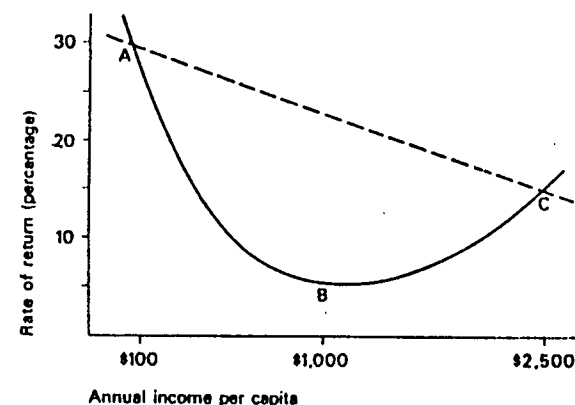


Figure 1.3. A rate of return to investment in education — level of economic development pattern.

Next, we attempted to find if there is any relationship between the rate of return and relative enrolments. Although no statistically significant relationship was found, the declining pattern repeated itself as illustrated in Figure 1.4. That is, the higher the enrolment in one educational level relative to the preceding one, the lower the rate of return to the former level.

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[8] An alternative non-monetary index of economic development was tried, namely the percentage of agriculture in the composition of gross domestic product, but this measure did not result in a better fit than per capita income.
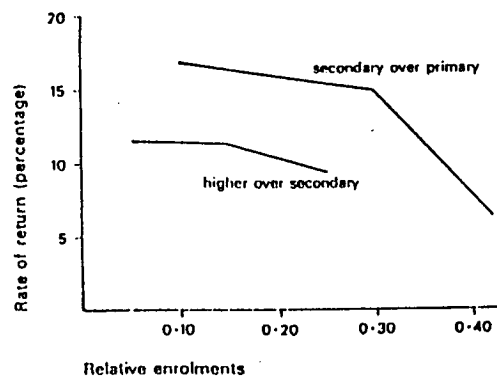
Figure 1.4. A rate of return to investment in higher and secondary education — relative enrolments pattern (intercountry averages).

## Human versus physical capital in economic development

In the second half of Chapter 6 we investigate to what extent differences in physical or human capital endowments help in explaining differences in per capita incomes between the countries of the sample. For this purpose two indices are constructed. First, the value of physical capital per member of the labour force; and second, the value of human capital per member of the labour force. In rich countries with per capita incomes around $2,000, the physical capital measure averages around $19,000 and the human capital measure around $7,000. In countries with per capita incomes around the $300 mark, the value of physical capital per member of the labour force is about $4,000 and the value of human capital $600. Countries with per capita income below $100 have corresponding values of $800 and $80. The value of human capital is always less in absolute terms than physical capital within a given country, but whereas in rich countries human capital represents 38 per cent of the value of the physical capital stock, this proportion drops to 10 to 15 per cent for the lower-income-group countries. Stated in another way, the inequality between countries in terms of human capital endowments is greater than the inequality of per capita income or physical capital. These relationships are illustrated in Figure 1.5.

A cross-country aggregate production function was fitted to these data on human and physical capital stocks in an attempt to explain income differences. The production function was run in two alternative specifications. In the first formulation of the function there were three inputs: physical capital, human capital, and total number
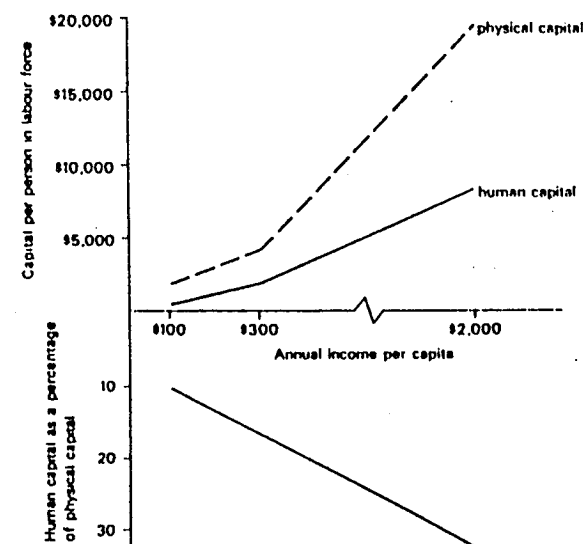


Figure 1.5. The relationship between human and physical capital by level of economic development (intercountry averages).

of persons employed. In the second formulation, physical capital was used along with three non-homogeneous labour inputs based on level of educational attainment as the explanatory variables. The results of these regressions indicate that human capital explains income differences better than does physical capital.

When the production function was run in terms of two distinct capital inputs, human capital showed a higher output elasticity (0.47) than physical capital (0.26), with crude labour showing the lowest elasticity (0.19). When the function was fitted using three distinct labour inputs, the elasticity of labour with secondary qualifications was the highest (0.37) followed by that of primary school graduates (0.14) and finally, higher education graduates (0.03).

The fitting of these functions permitted us to estimate shadow prices for the different inputs. The results seem to confirm earlier findings, that labour with secondary schooling has the highest marginal product, but it should be emphasized that the regression coefficients had large standard errors and hence little significance ought be attached to them. The shadow marginal productivity of physical capital was found to be not very different from observed profit rates (7 to 13 per cent depending upon the function specification), while the productivity of human capital was equal to 32 per cent. Regarding shadow and actual wages, secondary school graduates seem to receive about half of what they contribute to production,
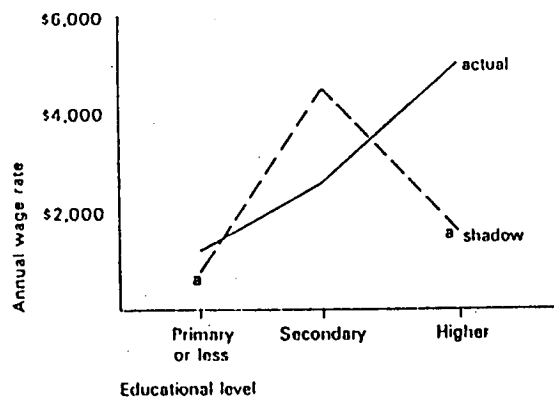
Figure 1.6. The relationship between actual and shadow wages by educational level of labour force (intercountry averages).



Figure 1.7. The contribution of education to growth by level of economic development (intercountry averages).

primary graduates appear to be slightly overpaid. Figure 1.6 illustrates the relationships as found in these calculations between shadow and actual wages for three categories of educated labour.

In the last section of Chapter 6 a generalized physical-human capital accumulation model is presented in an attempt to put together the bits and pieces of the partial relationships presented above.

## The contribution of educational investment to economic growth

In Chapter 7 we put the rate of return to another use namely to account for differences in the rates of economic growth of the countries in the sample. This was done by means of two computational variants of a growth accounting equation. First, a Schultz-type growth accounting framework was used, where the rate of return to a given educational level is multiplied by the investment in that level so as to arrive at a rental, which is then related to the increase in national income. Next, we used a cross-sectional Denison-type growth accounting framework where individual countries are treated as temporal states in the process of growth. Finally, the results of these exercises are compared with those obtained by orthodox (time-series) Denison-type growth accounting.

The results of this growth exercise show that the contribution of education as a percentage of the rate of economic growth ranges between 4 and 23 per cent. Advanced countries such as Great Britain, Norway and The Netherlands show the lowest contributions.
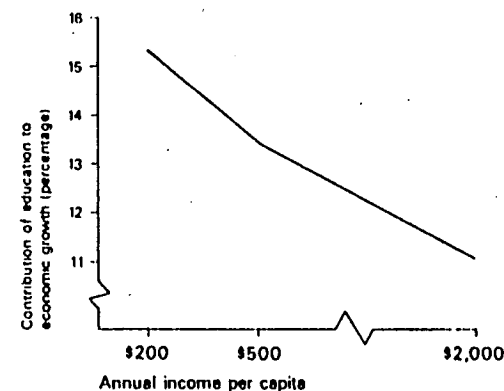
Aggregating countries into three groups we observe that although the returns to investment in education differ greatly between countries this is not the case for the contribution of education to growth. As Figure 1.7 illustrates, rich countries centering around the $2,000 per capita income mark show a contribution of education to growth of 11.2 per cent; countries in the $500 income group 13.7 per cent; and countries below the $200 per capita income mark 15.5 per cent.

When the contribution of education to growth is disaggregated by level of education, the primary and secondary levels average 46 and 40 per cent respectively of the total educational contribution for the sample as a whole, while the contribution of higher education amounts to the remaining 14 per cent.

## On relative costs and earnings

In the last two chapters of the book we have disaggregated the rate of return statistic into its two separate components, costs and benefits. Looking at the costs first, we observe that many countries in the sample still devote most of their educational resources to primary schooling, about half the countries to secondary and only three to higher education.

Next, we were able to derive some comparative relative annual cost data to illustrate how expensive higher education is in terms of the cost of primary education in different countries. The result of this exercise is illustrated in Figure 1.8, which shows that the cost of one year of higher education in poor countries is 88 times the cost of primary
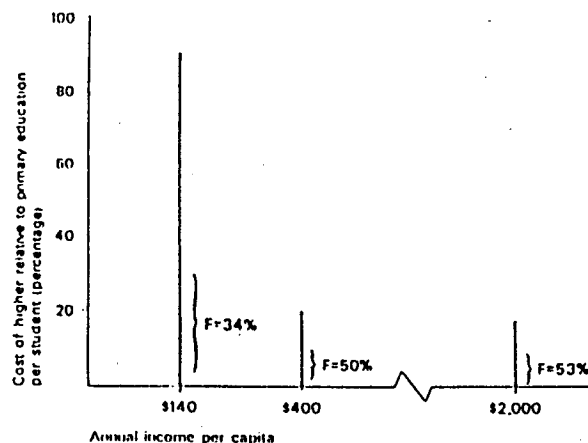
Figure 1.8. The cost of higher education relative to primary by level of economic development (intercountry averages) (F = percentage of earnings foregone in total cost).

education, whereas in rich countries the relative cost is only 18.

On the question of the composition of costs, 53 per cent of the total cost of higher education in rich countries is composed of foregone earnings, whereas the corresponding figure for poor countries is 34 per cent.

Turning to the relative earnings, the differentials decrease as the level of development rises. For example, higher education graduates seem to receive almost six-and-a-half times as much as primary school graduates in poor countries, while this proportion drops to around two-and-a-half in rich countries. Figure 1.9 illustrates the relationship between earnings differentials and the level of development.
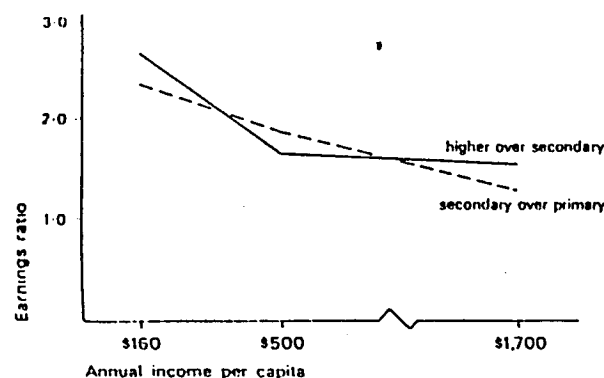


Figure 1.9. Earnings differentials between educated labour by level of economic development (intercountry averages).

## The degree of substitution between different types of educated labour

When the proportions of persons employed with different educational qualifications are related to the wages they receive, it is possible to arrive at an estimate of the ease of substitution between different kinds of labour in production. This was done in Chapter 9 of this study and the results show that the degree of substitution between all categories of educated labour is substantial but that persons with lower educational qualifications are more easily substitutable than those with higher educational qualifications. The different values of the elasticity of substitution ($\sigma$) between pairs of educated labour are illustrated in Figure 1.10.
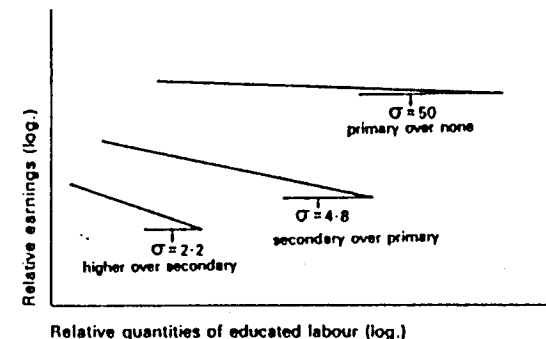


Figure 1.10. The elasticity of substitution between different kinds of educated labour.

Another result from this analysis is that physical capital is positively related to earnings differentials in developed countries. This is interpreted as evidence of the complementarity between physical and human capital.

## And on some hypotheses about international migration

We have started this book by looking into rates of return at different educational levels and have then disaggregated the rate of return into its components of costs and benefits. In the final section of the book we again synthethize costs and benefits but into a new profitability measure. This is named the cross-rate of return to investment in education, and is a profitability measure which refers to the combined investment activity of university graduation at home and subsequent emigration to the United States.

The result of this exercise is twofold. First, in the historical sense, the cross-rates of return appear to be in all cases substantially higher than the returns to alternative investments, such as those in physical capital or even investment in higher education when the graduate is domestically employed. If we split the sample into two groups, the upper-income countries show an average cross-rate of return of 31 per cent and a domestic rate of return to higher education of 14 per cent. In lower-income countries the cross-rates of return have values of over 50 per cent, whereas the domestic rate is 25 per cent. Second, in the behavioural sense, the cross-rates of return seem to "explain" the brain drain better than do conventional standard-of-living measures. Using data on immigration to the United States, we tested the hypothesis that relative flows are a positive function of the cross-rate of return and a negative function of the domestic rate. On both counts this hypothesis could not be statistically rejected.

## Synopsis

It is customary, at the end of a study like this to print two statements. First, that because of data limitations, coverage and the like, too generalized implications should not be drawn from it. Second, that further research on the subject is needed in order to provide conclusive answers to the questions asked.

In this respect this study does not depart from custom. Before any conclusive statements are made on the relationships between education and economic development, more solid evidence on the returns to education in some of the countries we have covered, and of course in additional countries, is needed. Moreover, the usual word of caution is particularly relevant in our case, for the first thing we have learned is that one should be very cautious in adopting profitability evidence in view of the adjustments that the estimate may contain and the differences in data reliability. In this study every effort has been made to remove the various adjustments but a great deal of unmatched data must still remain. It must also be remembered that some people go so far as to reject completely cost-benefit considerations as applied to education. As this issue has become more or less a matter of religion (i.e. either you believe in it or not) the agnostic or uncommitted reader should study the facts carefully before he adheres to a particular dogma. It is my hope that Chapter 2 will be of help in this respect.

Bearing in mind these qualifications, the results presented in this study seem to indicate the following:

(a) Whether one approves or disapproves of economic analysis applied to education, it is a statistical fact that education has both a private and a social monetary payoff and that this payoff is substantially higher in less-developed than in advanced countries. This statement does not deny that education has other than monetary effects. All it says is that by treating education as a form of investment we can quantify *at least one* of its multiple effects.

(b) The most profitable educational level in most countries is the primary one, while higher education shows a modest payoff, particularly in advanced countries. This suggests that arguments for universal primary education based on human rights are also supported by good economic sense.

(c) Returns to investment in human capital are well above the returns to physical capital in less-developed countries, while the two types of return are of almost equal magnitude in advanced countries. What this suggests is that less-developed countries should give greater emphasis to investing in human as against physical capital, while in advanced countries considerations other than economic payoff (for example, equal opportunity) must be invoked to justify the further expansion of the educational system.

(d) Per capita income differences can be better explained by differences in the endowments of human rather than physical capital.

(e) Furthermore, looked at from another point of view, investment in education contributes substantially to the rate of growth of output in most countries, particularly in the less-developed group.

(f) Labour with secondary educational qualifications seems to contribute in effect more to output than it is paid for.

(g) Higher education is very expensive in relation to the other levels of education, particularly in less-developed countries. This suggests that planners should be particularly careful to assess the benefits from this level of education before proposing expansion.

(h) Earnings inequality by educational level decreases as the level of development rises, but the growth of physical capital in the developed countries appears to work against further movements towards earnings equality.

(i) There is a high degree of substitution in production between different types of educated labour. What this suggests is that future expansion of the educational system should be based on calculations of relative costs and benefits rather than on "manpower needs".

(j) There is a very handsome return for those who graduate in the home country and subsequently emigrate to the United States. This economic payoff explains the phenomenon of the brain drain better

than more conventional measures such as differences in the standard of living.

One of the major points shown by this study is the weak position of higher education in terms of economic payoff in advanced countries. The following quotation is for those who believe that everything has been said before by Marshall:

> "The growth of general enlightenment . . . has turned a great deal of the increasing wealth of the nation from investment as material capital to investment as personal capital. There has resulted a largely increased supply of trained abilities which has much increased the national dividend, and raised the average income of the whole people: but it has taken away from these trained abilities much of that scarcity value which they used to possess, and has lowered their earnings . . ., and it has caused many occupations, which not long ago were accounted skilled . . . to rank with unskilled labour as regards wages."[9]

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[9] Marshall (1920), pp. 681—2.

# Chapter 2. Rate of Return Estimation Procedures

In this chapter we will describe the theoretical and empirical aspects underlying rate of return analysis and in particular we will deal with the various assumptions and methodologies used in the calculation of estimates. The different theoretical rate of return types are discussed first and then we consider types of earnings data used in the actual calculations. Finally we discuss the multiplicity of adjustments performed on the earnings or cost side mostly as a compromise towards a theoretically correct profitability measure.

But first we should explain why we deal with rates of return rather than with present values. It is well known that these two profitability measures of investment compete with each other and moreover that the present value is allegedly a more correct measure.[1] We will not enter here into a discussion of the pros and cons of the two approaches but the reader is referred to the rich literature on the subject.[2] Suffice it to mention that 28 out of 53 profitability studies we have reviewed were only in terms of rates of return, fifteen of them presented both present values and rates of return, and only five of them were exclusively in terms of present values. If by nothing else, the rate of return measure has won the race by popular demand! Of course, all authors have been aware of the weakness of the approach, but they have not considered that these weaknesses were enough to invalidate their results.[3] For example, one of the objections to rate of return analysis is that the relevant equation might have more than one solution or yield imaginary numbers. But age—earnings profiles that cross more than once are rare. Certainly, the popularity of the rate of return lies in the fact that it can be readily compared with similarly calculated yields on other investment projects.

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[1] Provided, of course, that total funds available for investment are unlimited. But with a restricted budget the rate of return provides a correct investment criterion.

[2] See in particular Hirshleifer (1958), Bailey (1959) and Ramsey (1970).

[3] For a collection of every conceivable objection to cost-benefit analysis applied to education, see Leite et al. (1969), Volume IIIA.